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FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)
215245US6XPCT	09/926402

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/FR00/01097	26 April 2000	30 April 1999

TITLE OF INVENTION

METHOD FOR THE MAKING OF SOLDER CONNECTION PADS ON A SUBSTRATE AND GUIDE FOR THE IMPLEMENTATION OF THE METHOD

APPLICANT(S) FOR DO/EO/US

PILAT Eric

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☐ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Request for Consideration of Documents Cited in International Search Report/Request for Priority
PCT/IB/304/Drawings (4 Sheets)/PCT/IB/308

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U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/926402	PCT/FR00/01097	215245US6XPCT

24. The following fees are submitted:.	CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1040.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$740.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	28 - 20 =	8	x $18.00	**$144.00**	
Independent claims	2 - 3 =	0	x $84.00	**$0.00**	
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**	

TOTAL OF ABOVE CALCULATIONS =	**$1,034.00**	
☐ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.	**$0.00**	
SUBTOTAL =	**$1,034.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +	**$0.00**	
TOTAL NATIONAL FEE =	**$1,034.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐	**$0.00**	
TOTAL FEES ENCLOSED =	**$1,034.00**	
	Amount to be: refunded	$
	charged	$

a. ☒ A check in the amount of **$1,034.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **15-0030** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Surinder Sachar
Registration No. 34,423

22850

Surinder Sachar
SIGNATURE

Gregory J. Maier
NAME

25,599
REGISTRATION NUMBER

Oct. 26 2001
DATE

09/926402

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215245US

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF :

ERIC PILAT : ATTN: APPLICATION DIVISION

SERIAL NO: NEW U.S. PCT APPLN :
(Based on PCT/FR00/01097)

FILED: HEREWITH :

FOR: METHOD FOR THE MAKING OF :
SOLDER CONNECTION PADS
ON A SUBSTRATE AND GUIDE
FOR THE IMPLEMENTATION
OF THE METHOD

09926402 - 102601

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Prior to a first examination on the merits, please amend the above-identified application as follows:

IN THE CLAIMS

Please amend Claim 22 as follows:

22. (Amended) A guide according to claim 15, wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

Please add new Claims 23-28 as follows:

23. (New) A guide according to claim 16, wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

24. (New) A guide according to claim 17, wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

25. (New) A guide according to claim 18, wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

26. (New) A guide according to claim 19, wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

27. (New) A guide according to claim 20, wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

28. (New) A guide according to claim 21, wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

IN THE ABSTRACT OF THE DISCLOSURE

Please amend the abstract as follows:

ABSTRACT OF THE DISCLOSURE

A method for molding and soldering electrical connection pads to the electrical connection-receiving zones of electronic components or circuits includes an operation for the injection of conductive liquid alloy into a guide open at one end placed so as to face the connection-receiving zone of the component. The guide is formed by two separable parts, a mold and an injection matrix, the mold and the injection matrix including passages, with a narrowing of the guide at the level of the separation of the parts, and the parts of the guide are separated while the alloy is in the liquid state. Such a method may find particular application to, as an example, making connection pads for substrates or electronic components.

REMARKS

Favorable consideration of this application, as presently amended, is respectfully requested.

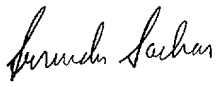
The present preliminary amendment is submitted to correct for minor informalities in the above-identified application.

By the present preliminary amendment, the multiple dependency of Claim 22 has been cancelled. Further, the subject matter of the cancelled multiple dependency is now set forth in new dependent Claims 23-28. The Abstract has also been amended by the present response to be in more proper format under United States practice.

The present application is believed to be in condition for a full and thorough examination on the merits. An early and favorable consideration of the present application is hereby respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



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Marked-Up Copy
Serial No:

Amendment Filed on:
10-26-01

IN THE CLAIMS

--22. (Amended) A guide according to [one of the claims] claim 15 [to 21], wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

Claims 23-28 (New).--

IN THE ABSTRACT

--ABSTRACT OF THE DISCLOSURE

[METHOD FOR THE MAKING OF SOLDER CONNECTION PADS ON A SUBSTRATE AND GUIDE FOR THE IMPLEMENTATION OF THE METHOD]

A method for molding and soldering electrical connection pads to the electrical connection-receiving zones of electronic components or circuits [comprises] includes an operation for the injection of conductive liquid alloy into a guide open at one end placed so as to face the connection-receiving zone of the component. The guide is formed by two separable parts, a mold and an injection matrix, the mold and the injection matrix [comprising] including passages, with a narrowing of the guide at the level of the separation of the parts, and the parts of the guide are separated while the alloy is in the liquid state.

[Applications:] Such a method may find particular application to, as an example, making [of] connection pads for substrates or electronic components.

[Figure 8]--

4 IPRTS

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METHOD FOR THE MAKING OF SOLDER CONNECTION PADS ON A SUBSTRATE AND GUIDE FOR THE IMPLEMENTATION OF THE METHOD

The present invention relates to a method for the molding and soldering of electrical connection pads to the electric connection-receiving zones of circuits electronic circuits or components.

The electrical connections of electronic components such as integrated circuits comprising a large number of connection points are usually formed by solder balls soldered to metal connection-receiving zones of the substrate of the component. These connection-receiving zones are located on the face by which the component is attached to an electrical interconnection circuit.

A known method for making electrical connections of an integrated circuit comprises the following main steps: the manufacture of solder balls of the requisite diameter, the dipping of the balls in a flux and the deposition of the balls on the substrate of the component; the passage of the component equipped with balls through a furnace in order to carry out the soldering.

The balls are deposited on the substrate by a suction or screen type device depositing the balls on the connection-receiving zones of the component.

These devices are costly and the making of the balls and their storage is very costly.

Another technique consists in making and soldering balls by means of the reflow of solder paste deposited by silk-screen process on the connection-receiving zones of the component. The solder paste is subjected to silk-screen process through two masks superimposed on the substrate. The top mask is used only to deposit the paste. The other mask serves as a mold and remains in position until the reflow of the solder paste in a through furnace. Owing to the presence of the flux, the substrates and the masks have to be cleaned.

Even if the solder paste is three to five times less costly than a prefabricated ball, the need to use these masks means that this technique too is a very costly one.

In order to overcome the drawbacks of the prior art, the invention proposes

a method for making balls or solder connection pads on an electrically conductive connection-receiving zone of an electric component, the method comprising an injection of conductive liquid alloy into a guide open at one end placed so as to face the connection-receiving zone of the component, wherein the guide is formed by two separable parts, a mold and an injection matrix, the mold and the injection matrix comprising passages, with a narrowing of the guide at the level of the separation of the parts, and the parts of the guide are separated while the alloy is liquid.

In the method for making solder connection pads according to the invention, as described hereinafter, the mold is the part in direct contact with the substrate of the component, and the injection matrix is the other part.

In a first variant of the method according to the invention, the mold is removed from the component before the solidification of the alloy. The molten metal present on the connection-receiving zone of the component takes the shape of a ball when it cools down.

In another variant of the method, the mold is cooled below the liquidus point of the alloy so that the alloy gets solidified in the mold after the separation of the parts. The mold is separated from the component and, optionally, the alloy is remelted so that it takes the form of a ball.

The invention also relates to a guide for the making of balls or solder connection pads on electrically conductive connection-receiving zones of an electronic component, the guide being designed to contain a conductive liquid alloy and being open at one end, wherein it is formed by two separable parts comprising passages with a narrowing of the guide at the position of the separation of the parts.

In one embodiment of the guide, the two parts are separable in the direction of injection of the liquid alloy in the guide.

Other characteristics and advantages of the invention shall appear from the description of exemplary embodiments of the guide and of variants of the method according to the invention for molding and soldering the solder pads on a connection-receiving zone of the component. This description is made with reference to the

appended drawings, of which :

- Figures 1, 2, 3, 4 and 5 show different embodiments and variants of these embodiments according to the invention.

- Figure 6 shows a device for the implementation of the method for making solder pads according to the invention using the guide.

- Figures 7, 8, 9 and 10 show different phases of a first variant of the method according to the invention for molding and soldering solder pads to a component.

- Figures 11, 12, 13 and 14 show different phases of a second variant of the molding and soldering method according to the invention.

Figure 1 shows a guide 10 with several identical passages for the molding and soldering of electrical connection pads to connection-receiving zones 12 for the electrical connection of an integrated circuit 14.

The guide has a mold 16 and an injection matrix 18, each having two main parallel faces, one substrate face 20, one internal mold face 22 for the mold, and an internal face 24 and an external face 26 for the injection matrix.

The guide has, respectively, first passages 28 in the mold and second passages 30 in the injection matrix, each of the first passages being aligned coaxially along an axis XX' with one of the respective second passages facing it. The axis XX' is substantially perpendicular to the main faces of the guide.

The distribution of the passages in the guide is the same as that of the metal connection-receiving zones 12 of the integrated circuit 14, so that each of the metal zones of the integrated circuit in contact with the substrate face 20 of the mold 16 faces a passage of the guide.

In a first embodiment of the guide, the first and second passages have a truncated cone shape, the small diameters of the truncated passages facing each other at the level of the separations of the two parts of the guide so that when these faces (22, 24) are in contact, the passage in the guide comprises a narrowing or a sudden flexure in the diameter of the guide at the level of the separation of the parts.

In a first variant of the first embodiment of the guide, shown in figure 1, the

apertures with the smallest diameter of the first and second truncated passages respectively on the faces of the mold and the injection matrix in contact have substantially the same diameter d1.

In a second variant of this first embodiment, (Figure 2), the aperture of the first passage 28 of the mold facing the injection matrix has a diameter d2 greater than the diameter d3 of the aperture of the second passage 30 of the injection matrix facing the mold.

In a third variant of the first embodiment, (Figure 3), the aperture of the first passage (28) of the mold facing the injection matrix has a diameter greater than the aperture of the second passage (30) of the injection matrix facing the mold. Furthermore, the aperture of the side of the internal face 24 of the second passage 30 of the injection matrix 18 has a shoulder 29 which, when the mold and the injection matrix are in contact, penetrates into the first truncated passage 28 of the mold.

In this third variant, the shoulder 29 around the aperture of the injection matrix may be done by the machining of a part of the thickness of its internal surface 24 facing the mold, for example by means of a laser

In a second embodiment of the guide (Figure 4), the first passage 28 of the mold has an approximately semi-spherical shape, the biggest aperture being located on the substrate face 20 of the mold 16 and a small aperture being located on the internal face 22 of the mold. The second passage 30 has a truncated cone shape, and its smallest aperture is on the internal face 24 of the injection matrix 18 facing the small aperture of the first semi-spherical passage.

In a third embodiment of the guide (Figure 5), the first passage 28 in the mold is truncated, the smallest diameter of the first passage facing the injection matrix and the second passage in said injection matrix having a cylindrical shape with a diameter that is very small as compared with the smallest diameter of the first passage 28 in the mold 16.

The method according to the invention for the making of solder connection pads on the substrate of a component is implemented by means of the guide in two separable parts. To this end, a device 40, represented by a schematic drawing in Figure 6, produces the injection, into the passage of the guide 10, of the liquid alloy

for the molding of the electrical connections on the component 14.

The component 14 has a part 42 placed against it. This part 42 is pushed by an elastic element 44 against the guide 10 so that the connection-receiving zones 12 of the component are facing the first passages 28 of the mold.

The device 40 essentially has a closed container 46 containing a molten alloy 48. The alloy may be put under pressure by a gas 50 coming from a container 52 containing the gas under pressure.

During a molding of the electrical connections to the component 14, the molten alloy 48 under pressure fills a cavity 56 through a conduit 54 . This cavity 56 comprises an aperture 58 that includes all the passages of the guide 10. The component 14 is held by pressure on the guide, which itself is held flat against the aperture 58 of the cavity 56, closing this cavity. The face of the component 14 comprising the connection-receiving zones is placed flat against the substrate face 20 of the mold and the external face 26 of the injection matrix is placed flat against the face of the cavity 56 comprising the aperture 58.

The molten alloy 48 in the cavity 56 is injected under pressure into the guide and, through the second passages of the injection matrix, it rapidly fills the first passages 28 of the mold and wets the connection-receiving zones 12 of the component 14.

It is assumed that the connection-receiving zones of the component are neither oxidized nor polluted by organic matter. They are wettable by the molten alloy. If not, it is necessary first of all to carry out an additional cleaning step to prepare the substrates accordingly.

In the first variant, shown in figures 7 to10, of the method for molding and soldering electrical connection pads to the connection-receiving zones of the substrate of an integrated circuit package (component 14), the method comprises at least the following steps :

- First step (Figure 7) ; injection of the alloy : during the injection of the liquid alloy 48 under pressure into the passages of the guide, the mold 16 is held at a temperature below that of the injection matrix 18, but higher than the liquidus threshold of the alloy 48.

- Second step (Figure 8) ; separation of the mold from the injection matrix :

the injection pressure drops or is even reversed, the liquid alloy 48 withdraws into the injection matrix 18. The liquid alloy filling the mold 16 remains because the mold is colder than the injection matrix and the connection-receiving zone 12 which has been wet by the alloy has a greater surface area than the hole of the mold on the injection matrix side. The tension that holds the liquid alloy back is therefore greater than the tension that tends to draw it into the injection matrix. Then the mold is separated from the injection matrix, enabling a gas Gz that is an inert gas or even a reducing gas to protect the alloy, which is still in a liquid state, against oxidation. This same gas is also injected into the passages (or nozzles) of the injection matrix to keep it properly clean for the next cycle.

- Third step (see Figure 9) ; separation of the component (or substrate) from the mold : before the alloy solidifies, the component 14 is separated from the mold 16 ; despite the alignment defects, the alloy has wet a sufficient area of the connection-receiving zone 12 so that the liquid alloy 48 remains attached to the substrate of the component and not to the mold. The material of the mold (stainless steel 316L with chemical deburring, or graphite, or Teflon, or processed silicon for example) is chosen so as to minimize the surface tension between the alloy and the mold.

The liquid alloy 48 is always in a gaseous environment (Gz) comprising a neutral or even a reducing gas.

- Fourth step (Figure 10) ; solidification : Since the molten alloy no longer undergoes any mechanical stresses, it takes an almost spherical shape 60 for it is in this configuration that the surface tensions are reduced to the minimum. In cooling, the alloy gets permanently set in this shape.

Since there is no longer any need to use a flux, it is not necessary to clean the substrate of the component 14.

In the second variant, the method has at least the following steps :

- First step (Figure 11) : During the injection of the liquid alloy 48 under pressure into the passages of the guide, the mold 16 is at a temperature below the liquidus threshold of the alloy, but high enough to enable the wetting of the connection-receiving zones 12 and the filling of the passages.

- Second step (see Figure 12) ; solidification of the alloy in the mold,

separation of the mold from the injection matrix: the mold 16 is kept at a temperature below the liquidus threshold of the alloy so that the alloy solidifies rapidly in the first passages 28 of the mold. The injection pressure drops and the liquid alloy 48 withdraws into the injection matrix. The mold is separated from the injection matrix enabling a gas Gz that is a neutral gas or even a reduction gas to saturate the atmosphere beneath the alloy and in the passages of the injection matrix, so that it is well cleaned for the next cycle.

- Third step (see Figure 13) ; separation of the component (or substrate) from the mold : the lifting of the mold is facilitated because the shape of the first premier passage (or cavity) of the mold is open to the maximum on the substrate side, the mold is made of a material with an expansion coefficient lower than that of the alloy and a chemical deburring type of surface treatment is carried out on the first passage of the mold. The solidified pads 62 have substantially the shape of the first passages 28 in the mold.

- Fourth step (Figure 14) ; reflow of the solidified pads 62 : this step is necessary to obtain connections in the form of balls 64 that are perfectly positioned with respect to their connection-receiving zone 12. This operation can be done in batches in a stove in an environment containing a neutral gas such as nitrogen. Since the alloy undergoes no mechanical stress whatsoever, it takes a regular spherical shape corresponding to the configuration of minimum surface tension. This reflow operation requires no flux, or else a flux with low activity, and it is not necessary to clean the substrate after the reflow operation.

These methods according to the invention have the advantage of using solid tin in the form of rods at a cost that is far smaller than the cost of the solder paste or balls used in the prior art methods. Moreover, the problem of storage is far smaller.

In the first and second variants of the method for making solder connection pads, it is possible to improve the break of the solder between the two parts of the guide at the time of their separation. To this end, the guide is made to vibrate at the time of the separation of the parts, so that this break takes place always at the same place at the level of the narrowing of the guide. This provides for high reproducibility of the volume of the solder connection pads.

Another advantage of the method according to the invention lies in the fact that it enables the shaping and soldering of the connection to the connection-receiving zone in a single step, possibly with a reflow operation in a stove, whereas the other principles of the prior art require, in addition, the use of a silk-screen printing machine and/or ball placing machine, a through furnace or even a cleaning machine. The cost of making the associated machine will, in principle, be twice as small. Finally, the tools associated with each product will be far less costly.

WHAT IS CLAIMED IS :

1. A method for making balls or solder connection pads on an electrically conductive connection-receiving zone of an electric component, the method comprising an operation for the injection of conductive liquid alloy into a guide open at one end placed so as to face the connection-receiving zone of the component, wherein the guide is formed by two separable parts, a mold and an injection matrix, the mold and the injection matrix comprising passages, with a narrowing of the guide at the level of the separation of the parts, and the parts of the guide are separated while the alloy is in the liquid state.

2. A method according to claim 1, wherein, the mold is removed from the component before the solidification of the alloy, the molten metal present on the connection-receiving zone of the component taking the shape of a ball when it cools down.

3. A method according to claim 1, wherein the mold is cooled below the liquidus point of the alloy so that the alloy gets solidified in the mold after the separation of the parts, the mold is separated from the component and, optionally, the alloy is remelted so that it takes the form of a ball.

4. A method according to claim 2, comprising the following steps:

- the positioning the component on the mold and the holding of the component by pressure on the mold, then the injecting of liquid alloy under pressure into the guide, the rapid filling of the first passages of the mold and the wetting of the connection-receiving zones of the component, the mold being at a temperature below that of the injection matrix but higher than the liquidus threshold of the alloy.

- the withdrawal of the liquid alloy into the injection matrix followed by the separation of the mold from the injection matrix, the liquid alloy filling the first passages of the mold that remain in the mold, the mold being colder than the injection matrix and the connection-receiving zone which has been wet by the alloy having a greater surface area than the hole of the mold on the injection matrix side.

- the separation of the component of the mold before the alloy solidifies, the alloy having wet a sufficient surface area of the connection-receiving zone so that the liquid alloy remains clinging to the component and not to the mold.

- the cooling of the alloy producing its solidification in the form of a sphere.

5. A method according to claim 4, wherein the withdrawal of the alloy from the injection matrix is obtained by a reversal of the pressure of injection of the liquid alloy into the guide.

6. A method according to claim 4, wherein the withdrawal of the alloy from the injection matrix is obtained by a drop in the pressure of injection of the liquid alloy into the guide.

7. A method for making solder pads on a substrate according to claim 3, comprising the following steps :

- the positioning of the component on the mold and the holding of the component by pressure on the mold, then the injecting of liquid alloy under pressure into the guide, the rapid filling of the first passages of the mold and the wetting of the connection-receiving zones of the component, the mold being at a temperature below the liquidus threshold of the alloy but high enough to enable the wetting of the connection-receiving zones and the filling of the passages.

- the holding of the mold at a temperature below the liquidus threshold of the alloy so that it solidifies rapidly in the first passages of the mold;

- the withdrawal of the liquid alloy into the injection matrix followed by the separation of the mold from the injection matrix,

- the separation of the component from the mold revealing solder pads soldered to the connection-receiving zones, having the shape of the first passages of the mold.

8. A method according to claim 7, wherein the withdrawal of the alloy from the injection matrix is obtained by a drop in the pressure of injection of the liquid alloy into the guide.

9. A method according to claim 7, wherein a reflow of the solder pads is carried out, making it possible to obtain connections in the forme of balls that are perfectly positioned with respect to the connection-receiving zone.

10. A method according to claim 9, wherein the reflow of the pads is done in batches in a stove with a neutral environment of the nitrogen type.

11. A method according to claim 1, wherein the guide is made to vibrate at the time of the separation of the parts, so that the break of the solder between the

two parts of the guide takes place at the same place at the level of the narrowing of the guide, thus providing for very high reproducibility of the volume of the solder connection pads.

12. A method according to claim 4, wherein an inert gas enables the saturation of the atmosphere beneath the alloy and in the second passages of the injection matrix.

13. A guide for the making of balls or solder connection pads on electrically conductive connection-receiving zones of an electronic component, the guide being designed to contain a conductive liquid alloy and being open at one end, wherein it is formed by two separable parts comprising passages with a narrowing of the guide at the level of the separation of the parts.

14. A guide according to claim 13, wherein the two parts are separable in the direction of injection of the liquid alloy in the guide.

15. A guide according to claim 13, comprising a mold 16 and an injection matrix 18, each having two main parallel faces, one substrate face, one internal mold face for the mold, and an internal face and an external face for the injection matrix, the mold and the injection matrix respectively comprising first passages in the mold and seconds passages in the injection matrix, each of the first passages being aligned coaxially along an axis XX' with one of the respective second passages facing it, the axis XX' being substantially perpendicular to the main faces of the guide.

16. A guide according to claim 15, wherein the first and second passages have a truncated cone shape, the small diameters of the truncated passages facing each other at the level of the separations of the two parts of the guide so that when these faces are in contact, the passage in the guide comprises a narrowing or a sudden flexure in the diameter of the guide at the level of the separation of the parts.

17. A guide according to claim 16, wherein the apertures with the smallest diameter of the first and second truncated passages respectively on the faces of the mold and the injection matrix in contact have the same diameter.

18. A guide according to claim 16, wherein the aperture of the first passage of the mold facing the injection matrix has a diameter greater than the diameter of

the aperture of the second passage of the injection matrix facing the mold.

19. Guide according to claim 16, wherein the aperture of the first passage of the mold facing the injection matrix has a diameter greater than the aperture of the second passage of the injection matrix facing the mold, a shoulder of the aperture on the internal face side of the second passage of the injection matrix penetrating, when the mold and the injection matrix are in contact, into the first truncated passage of the mold.

20. A guide according to claim 15, wherein the first passage of the mold is semi-spherical, the biggest aperture being located on the substrate face of the mold and a small aperture being located on the internal face of the mold, the second passage having a truncated cone shape, its smallest aperture being on the internal face of the injection matrix facing the small semi-spherical aperture of the first passage.

21. A guide according to claim 15, wherein the first passage in the mold is truncated, the smallest diameter of the first passage facing the injection matrix and the second passage in said injection matrix having a cylindrical shape with a diameter that is very small as compared with the smallest diameter of the first passage in the mold.

22. A guide according to one of the claims 15 to 21, wherein the mold is made out of a material chosen from among stainless steel 316L with chemical deburring, or graphite, or Teflon, or silicon.

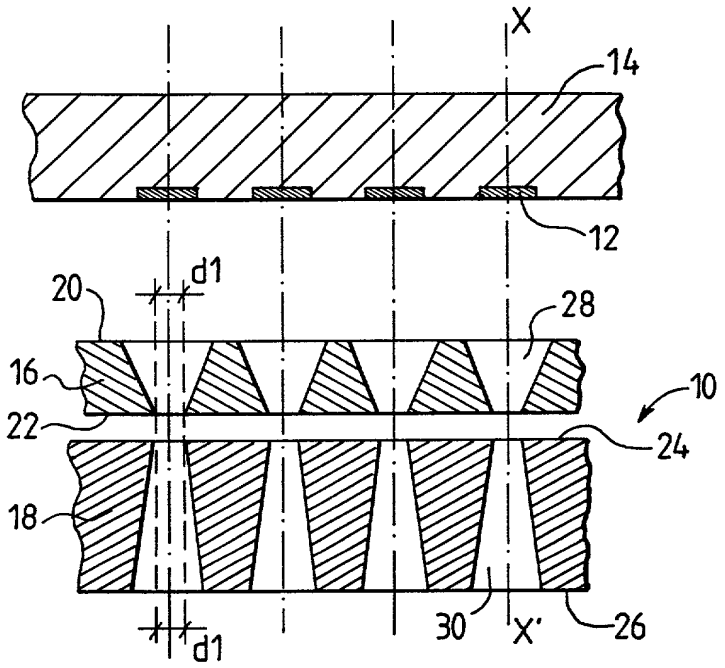

FIG.1

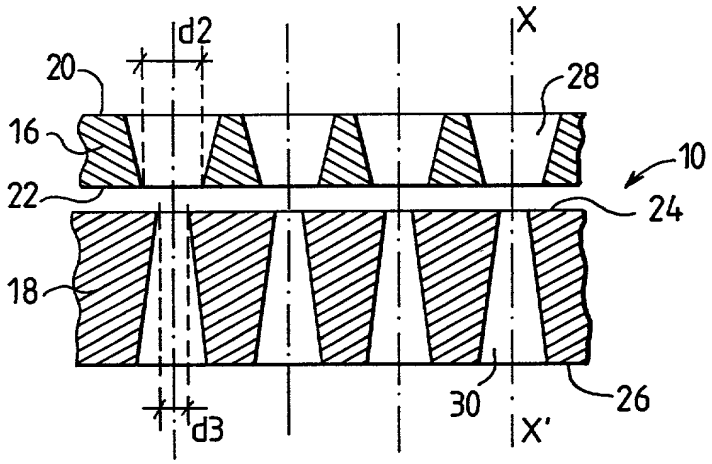

FIG.2

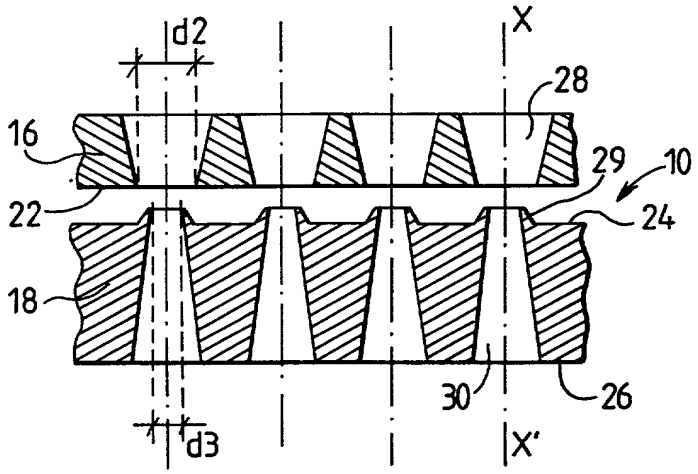

FIG.3

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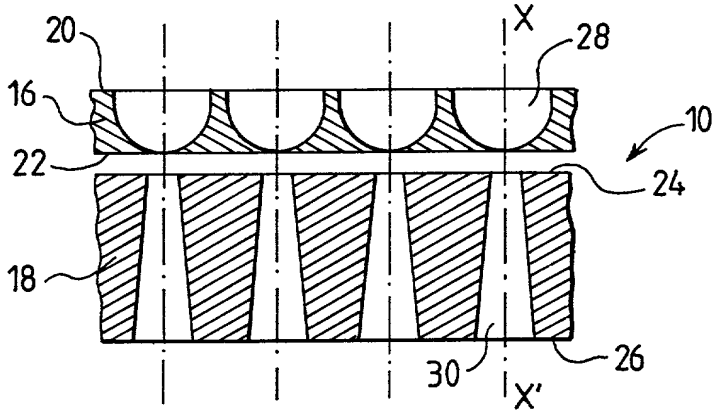

FIG.4

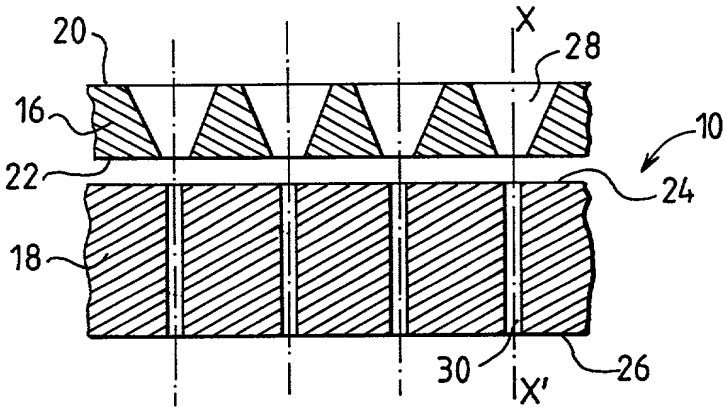

FIG.5

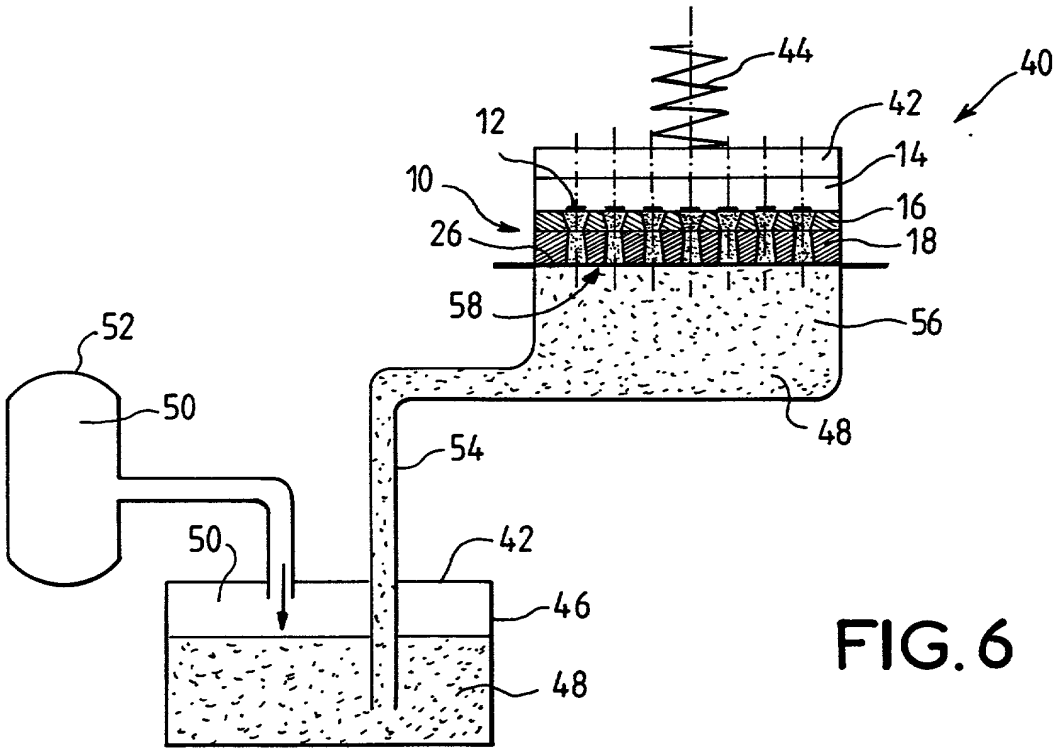

FIG.6

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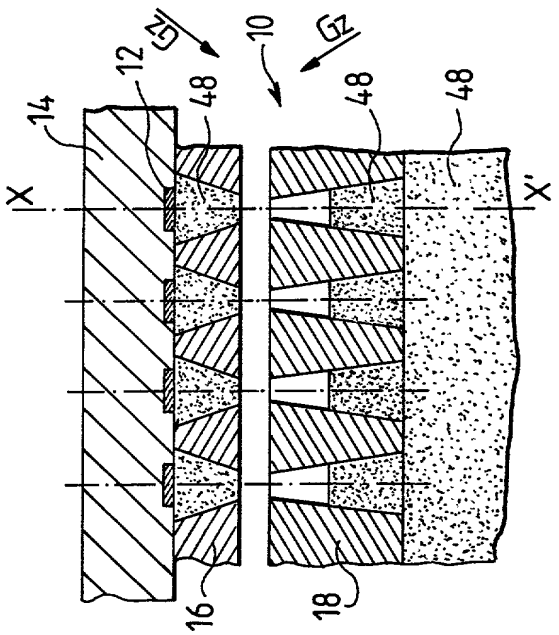

FIG.8

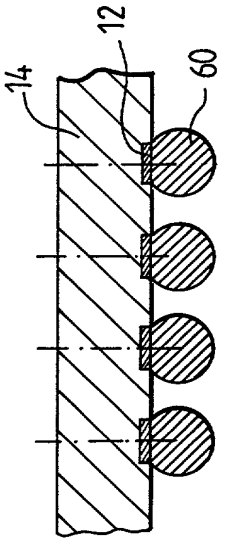

FIG.10

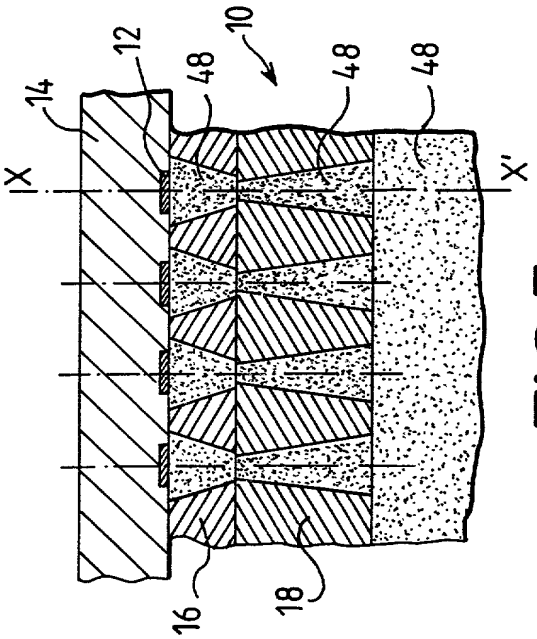

FIG.7

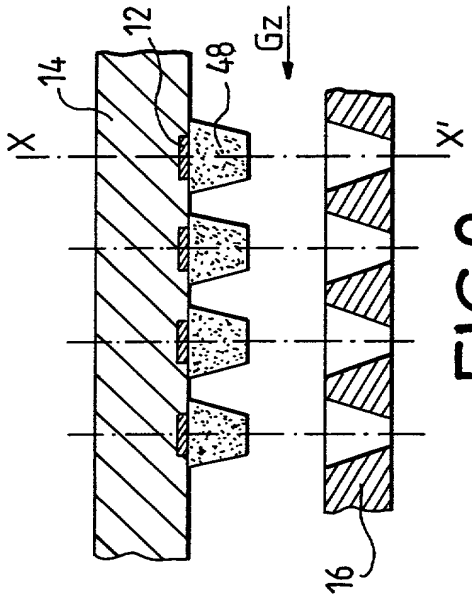

FIG.9

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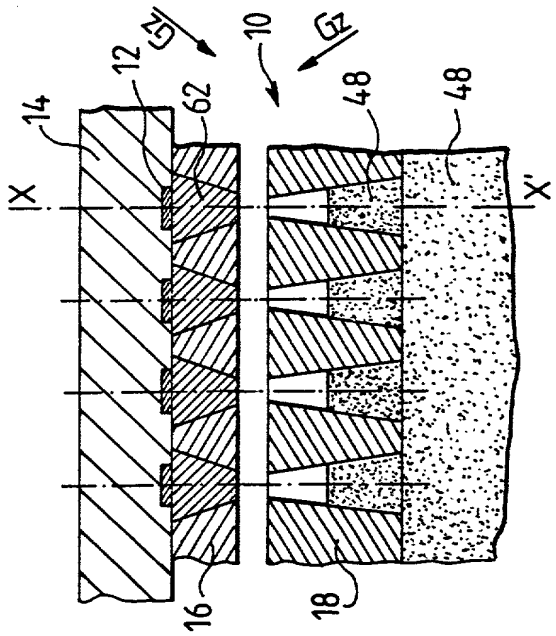

FIG.12

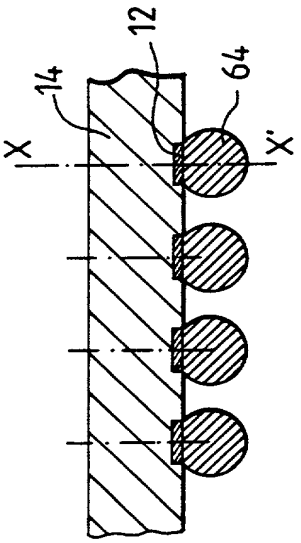

FIG.14

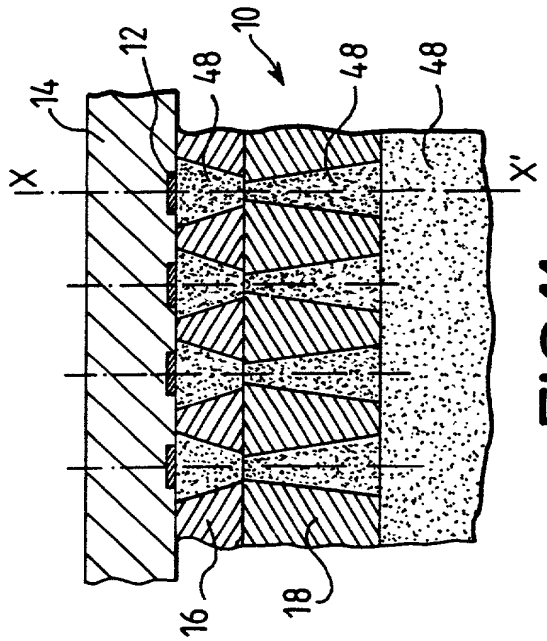

FIG.11

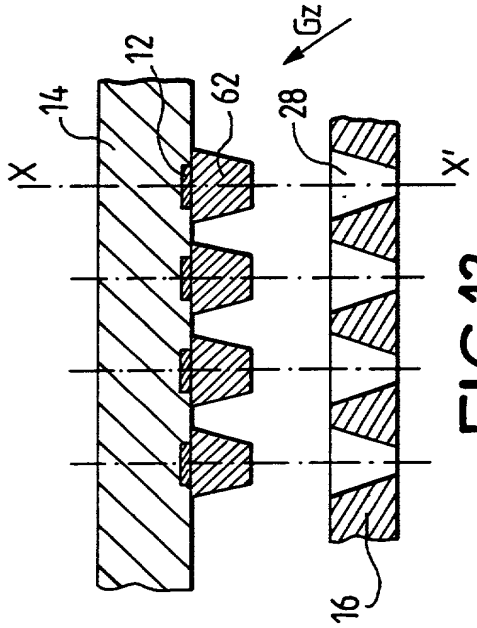

FIG.13

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Declaration and Power of Attorney for Patent Application
Déclaration et Pouvoirs pour Demande de Brevet

French Language Declaration

En tant l'inventeur nommé ci-après, je déclare par le présent acte que:

As a below named inventor, I hereby declare that:

Mon domicile, mon adresse postale et ma nationalité sont ceux figurant ci-dessous à côté de mon nom.

My residence, post office address and citizenship are as stated next to my name.

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) de l'objet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention intitulée

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD FOR THE MAKING OF SOLDER CONNECTION PADS ON A SUBSTRATE AND GUIDE FOR THE IMPLEMENTATION OF THE METHOD

et dont la description est fournie ci-joint à moins

the specification of which:

□ ci-joint

□ a été déposée le _____

sous le numéro de demande des Etats-Unis ou le numéro de demande international PCT

_____ et modifiée le

_____ (le cas échéant).

□ is attached hereto.

X□ was filed on April 26, 2000

as United States Application Number or PCT International Application Number

PCT/FR00/01097 and was amended on

_____ (if applicable).

Je déclare par le présent acte avoir passé en revue et compris le contenu de la description ci-dessus, revendications comprises, telles que modifiées par toute modification dont il aura été fait référence ci-dessus.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

Je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

French Language Declaration

Je revendique par le présent acte avoir la priorité étrangère, en vertu du Titre 35, § 119(a)-(d) ou § 365(b) du Code des Etats-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur ou, en vertu du Titre 35, § 365(a) du même Code, sur toute demande internationale PCT désignant au moins un pays autre que les Etats-Unis et figurant ci-dessous et, en cochant la case, j'ai aussi indiqué ci-dessous toute demande étrangère de brevet, tout certificat d'inventeur ou toute demande internationale PCT ayant une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée

I hereby claim foreign priority under Title 35, United States Code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below, and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
Demande(s) de brevet antérieure(s) dans un autre pays.

(Number) (Numéro)	(Country) (Pays)	(Day/Month/Year Filed) (Jour/Mois/Anné de dépôt)	Priority claimed Droit de priorité revendiqué: Yes Oui	No Non
99 05544	FRANCE	30 APRIL 1999	XX	☐
			☐	☐

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 119(e) du Code des Etats-Unis, de toute demande de brevet provisoire effectuée aux Etats-Unis et figurant ci-dessous.

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below

(Application No.) (Nº de demande)	(Filing Date) (Date de dépôt)	(Application No.) (Nº de demande)	(Filing Date) (Date de dépôt)

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 120 du Code des Etats-Unis, de toute demande de brevet effectuée aux Etats-Unis, ou en vertu du Titre 35, § 365(c) du même Code, de toute demande internationale PCT désignant les Etats-Unis et figurant ci-dessous et, dans la mesure où l'objet de chacune des revendications de cette demande de brevet n'est pas divulgué dans la demande antérieure américaine ou internationale PCT, en vertu des dispositions du premier paragraphe du Titre 35, § 112 du Code des Etats-Unis, je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la demande antérieure et la date de dépôt de la demande nationale ou internationale PCT de la présente demande·

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application No.) (Nº de demande)	(Filing Date) (Date de dépôt)	(Status) (patented, pending, abandoned) (Statut) (breveté, en cours d'examen, abandonné)
PCT/FR00/01097	26 APRIL 2000	

Je déclare par le présent acte que toute déclaration ci-incluse est, à ma connaissance, véridique et que toute déclaration formulée à partir de renseignements ou de suppositions est tenue pour véridique; et de plus, que toutes ces déclarations ont été formulées en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d' une incarcération, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des Etats-Unis, et que de telles déclarations volontairement fausses risquent de compromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon

French Language Declaration

POUVOIRS: En tant que l'inventeur cité, je désigne par la présente l'(les) avocat(s) et/ou agent(s) suivant(s) pour qu'ils poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire s'y rapportant avec l'Office des brevets et des marquees: *(mentionner le nom et le numéro d'enregistrement)*

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: *(list name and registration number)*

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(703) 413-3000

Nom complete de l'unique ou premier inventeur	Full name of sole or first inventor Eric PILAT October 8, 2001
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Nom complete du second co-inventeur, le cas echeant	Full name of second joint inventor, if any
Signature de l'inventeur Date	Second inventor's signature Date
Domicile	Residence
Nationalité	Citizenship
Adresse Postale	Post Office Address

(Fournier les mêmes renseignements et la signature de tout co-inventeur supplémentaire.)

(Supply similar information and signature for third and subsequent joint inventors.)

1/00